Los Angeles District

San Clemente Shoreline Study

Economic Appendix

Economic & Social Analysis Section
April 2004

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1 Study

A Study Purpose

The purpose of this economic appendix is to present the evaluation for the F3 milestone. The F3 milestone evaluation presents a feasibility-level investigation to determine the average annual storm-related damages to shoreline properties and infrastructure along the shoreline in the City of San Clemente. A detail analysis of cost/benefit analysis of the proposed alternatives will be presented for the future F4 milestone.

B Study Area

The current study area is bounded between San Mateo Point (located at the southern limits of City of San Clemente) and Dana Point Harbor. The study area is approximately 12.1 km (7.5 miles) long. The study area is further sub-divided into ten reaches for reference purposes numbered consecutively Reach 1 – Reach 10. Reaches 1 through 8 are located in the City of San Clemente. The study area is located on the Pacific Ocean coastline in the City of San Clemente, Orange County, California. It includes the entire San Clemente shoreline approximately 8 kilometers in length, from Shorecliff Beach to San Mateo Point. Narrow, sandy beaches, backed by high coastal bluffs, characterize the shoreline. Running along the entire length of the San Clemente shoreline is a portion of the Lossan (Los Angeles to San Diego) railroad corridor, a major passenger and cargo rail line linking San Diego to rest of the United States, owned by the Orange County Transportation Authority (OCTA). This commuter rail corridor is among the busiest in the country and separates the beach from the bluff. The study area southern boundary at San Mateo Point is the boundary between the counties of Orange and San Diego.

C Guidance and Regulation

This economic report is formulated to be in accordance with ER 1105-2-100. The damages and costs are expressed as annual values are calculated utilizing the FY 04 discount rate of 5 5/8 percent with a project life of 50 years. All damages and costs are expressed at October 2003 price level. The base year and future year are 2010 and 2059 respectively.

D Historical Damages

Over the past 20 years, the beach width along San Clemente shoreline has experienced significant reductions. The reduction of the beaches along the shoreline has subjected the public facilities and private properties to wave-induced damages. These facilities include the Marine Safety Building, public restrooms, and concession stands. Table E1 shows the historical damages to public facilities along the shoreline. The meteorological conditions of El Nino occurred in the years 1983, 1988, and 1998. The majority repairs in the years of 1983 and 1988 were due to damages to the San Clemente Pier. The pier had spent $2,109,000 in repairs in 1983 and $2,305,000 in 1988. Also, the majority of

Table E1
Historical Damages Recreational Facilities
Oct 2003 Price Level

Year	Reason for Expenditure	Amount	Comments
1983	Facility Protection/Storm Damage Repair	2743000	El Nino Storms
1988	Facility Protection/Storm Damage Repair	2611000	El Nino Storms
1994	Storm Damage	18000	
1995	Storm Damage Repairs	6000	General Repairs
1996	Storm Damage Repairs	14000	General Repairs
1997	Facility Protection/Storm Damage Repair	45000	Repair of Marine Safety Sheet Pile
1998	Storm Damage Repairs	315000	General Repairs
1999	Storm Damage Repairs	43000	General Repairs
2000	Storm Damage Repairs	12000	General Repairs
2001	Storm Damage Repairs	53000	General Repairs
2003	Facility Protection	169000	Repair of Marine Safety Sheet Pile

damages ($288,000) in 1998 are due to repairs costs for a revetment in the community of Capistrano Shores. In addition, the city is spending $5,000 per year in using a tractor to reduce the steepness of the shoreline.

E Reach Boundaries

The reach boundaries are defined in meters northward from San Mateo Point and shoreline features located within each reach are described. Since the railroad is assumed to be a constant feature throughout the project lifecycle, the railroad tracks provided a convenient feature to define a horizontal alignment. The section of the study area that has the revetment to protect the railroad is sub-divided into cells with a length of 50 meters. The project reaches are defined based on an arbitrary assumed Station 0+000 at San Mateo Point. The study area is divided into 10 reaches. Reaches 10 and 9 are located north of city limits of San Clemente. Reach 10 is located from Capistrano Shores development to City of Dana Point. The Capistrano Shores (90 structures) development is located in reach 9. The boundaries for reaches 1 through 8 were based whether the boundaries included a revetment or no revetment along the railroad tracks.

<u>Reach 1</u>: Reach 1 extends from San Mateo Point at Station 0+146 to Station 1+115. The reach is 969 m long and is the southern portion of San Clemente State Beach. The beach width is zero at the southern boundary and gradually increases to 41 m wide. The railroad seaward slope incorporates the improved armor stone protection, has a slope of 1H:1V, and a crest elevation of approximately +7 m. There are no structures landward of the railroad; some residential structures exist immediately landward of the railroad. The cells in this reach are numbered from 1 through 19. The reach has a revetment that protects the railroad tracks.

<u>Reach 2</u>: Reach 2 extends from Station 1+115 to Station 1+795. The reach is 680 m long and is encompassed within San Clemente State Beach. The beach width is approximately 40 m wide at the southern boundary and gradually decreases to 9 m wide.

The railroad seaward slope incorporates the conventional ballast construction, has a slope of 1H:1V, and a crest elevation of approximately +6.4 m. There are no structures landward of the railroad; the underpass for San Clemente State Beach is included within this reach. The cells in this reach are numbered from 20 through 33. The reach does not have an existing revetment to protect the railroad tracks.

Reach 3: Reach 3extends from Sta 1+795 to Sta 2+395. The reach is 600 m long IS encompassed within San Clemente State Beach. The beach width is approximately 9 m wide at the southern boundary and quickly becomes zero throughout the remainder of the reach. The railroad seaward slope incorporates the improved armor stone protection, has a slope of 1H:1V, and a crest elevation of approximately +7 m. There are no structures landward of the railroad; Calafia Beach Park is on the landward side of the railroad. The cells in this reach are numbered from 34 through 45. This reach does have an existing revetment to protect the railroad tracks.

Reach 4: Reach 4 extends from Sta 2+395 to Sta 3+127. The reach is 732 m long and encompasses San Clemente State Beach on the southern 30% and City of San Clemente on the northern 70%. The beach width is approximately 30 m wide at the southern boundary, transitions to 60 m wide in the middle, and transitions to 10 m wide at the northern boundary. The railroad seaward slope incorporates the conventional ballast construction, has a slope of 1H:1V, and a crest elevation of approximately +6.3 m. There are no structures landward of the railroad; some residential structures exist immediately landward of the railroad. The cells in this reach are numbered from 46 through 60. This reach does not have an existing revetment to protect the railroad tracks.

Reach 5: Reach 5 extends from Sta 3+127 to Sta 3+540. The reach is 413 long and is encompassed within the City of San Clemente. The beach width is 0 m wide throughout the reach. The railroad seaward slope incorporates the improved armor stone protection, has a slope of 1H:1V, and a crest elevation of approximately +6.5 m. There are no structures landward of the railroad; some residential structures exist immediately landward of the railroad. The cells in this reach are numbered from 61 through 68. This reach does have an existing revetment to protect the railroad tracks.

Reach 6: Reach 6 extends from Sta 3+540 to Sta 4+580. The reach is 1040 m long and is encompassed within the City of San Clemente. The beach width meanders from 0 m wide to 23 m to 0 m to 39 m and back to 0 m along the reach. The railroad seaward slope incorporates the conventional ballast construction, has a slope of 1H:1V, and a crest elevation of approximately +6.9 m. This reach includes the majority of the significant structures along the beach. The cells in this reach are numbered from 69 through 89. This reach does not have an existing revetment to protect the railroad tracks.

Reach 7: Reach 7 extends from Sta 4+580 to Sta 5+661. The reach is 1081 m long and is encompassed within the City of San Clemente and is known as “Mariposa Point”. The beach width is 0 m wide throughout the reach. The railroad seaward slope incorporates the improved armor stone protection, has a slope of 1H:1V, and a crest elevation of approximately +6.9 m. Historical information indicates that this reach has been armored with revetment since at least the 1930’s. There are no structures seaward or landward of the railroad. The cells in this reach are numbered from 90 through 111. This reach does have an existing revetment to protect the railroad tracks.

Reach 8: Reach 8 extends from Sta 5+661 to Sta 6+008. The reach is 347 m long and is encompassed within the City of San Clemente. The beach width varies from 40 m wide at the southern boundary to 0 m at the northern boundary. The railroad seaward slope incorporates the conventional ballast construction, has a slope of 1H:1V, and a crest elevation of approximately +6.9 m. The cells in this reach are numbered from 112 through 112. This reach does not have an existing revetment to protect the railroad tracks. Also, the concession and restroom facility for the north beach is located within this reach.

Reach 9: Reach 9 extends from Sta 6+008 to Sta 7+109. The reach is 1101 m long and is encompassed within the City of San Clemente and is known as “Capistrano Shores”. Capistrano Shores is a private community of manufactured housing constructed in the 1950’s. A timber seawall that is fronted by a rubblemound rock revetment protects the reach. The armor stone is estimated to be 2-5 tons, has a slope of 1H:1V, and a crest elevation of approximately +6.0 m. The general condition of the revetment is not uniform and appears to be fair/poor along the entire length. The beach width is 0 m wide throughout the reach. The railroad is located substantially landward of the revetment and as such is no longer considered the project landward boundary. There are no structures seaward of the revetment. This reach is subdivided into 91 cells. Each cell is based on the boundary of a parcel with a manufactured structure.

Reach 10: Reach 10 extends from Sta 7+109 to Dana Point Harbor. The reach is approximately 5,000 m long and extends to the northern boundary of the study area.

The following figures represent aerial photographs of the ten reaches. Figure 1 shows Reach 10 and entire study area. Figure 2 shows the community of Capistrano Shores or reach 9. The aerial photograph for reaches 1 through 8 is shown in Figure 3.

Figure 1

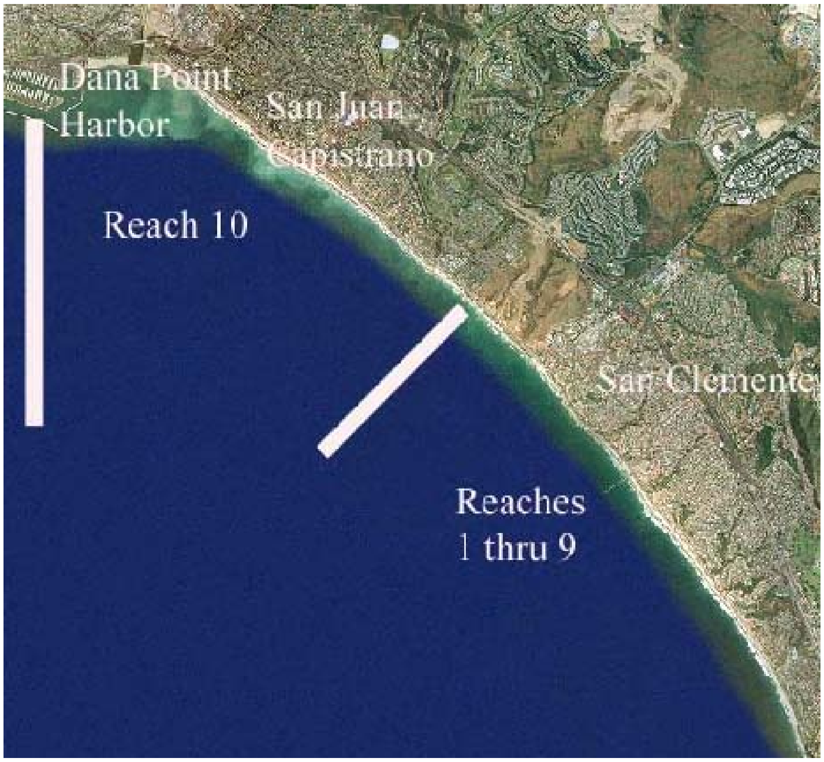
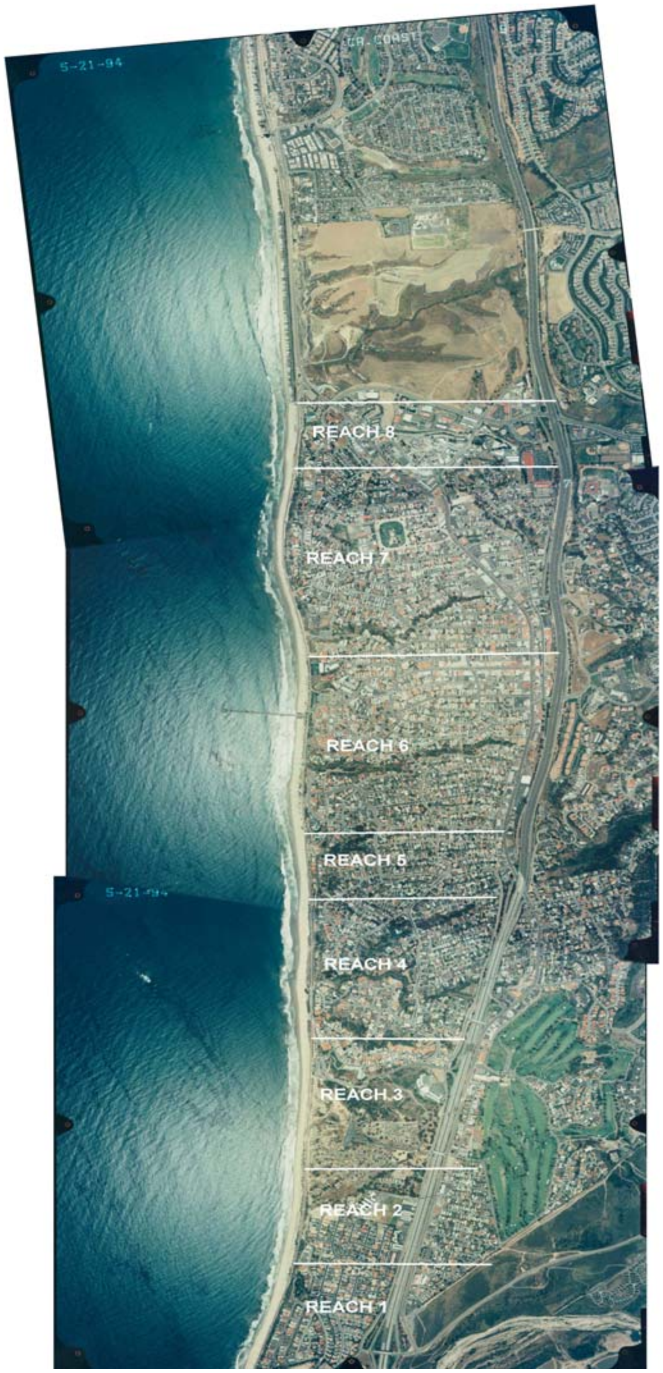


Figure 2

Figure 3



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REACH 8
REACH 7
REACH 6
REACH 5
REACH 4
REACH 3
REACH 2
REACH 1

2 Demographic Data

A Socio-economic Profile

The city of San Clemente is located within Orange County 60 miles south of Los Angeles, and 58 miles north of San Diego. San Clemente is located along Interstate 5 and is bordered on its western side by the Pacific Ocean. It is the midpoint between Los Angeles and San Diego.

B Population

The majority or 60-percent of Californians live in Southern California. The 2001 Census reported that Orange County has a population of 2,890,444 with San Clemente reporting a population of 60,701. San Clemente is comprised of 17.8 square miles.

The population of Orange County in 2000 comprised 8-percent of the population of California; the county population was 2,846,289 and the state population was 33,871,648. Using the U.S. Bureau of Economic Analysis projection data for the State of California, the state is expected to experience a population increase of more than 28-percent by 2025, a considerable faster rate of growth than the United States (23%).

Table E2
San Clemente Shoreline Study
Comparative Population Data (1980 to 2025)

	1980	1990	2000	2025	%change
San Clemente	27,325	41,100	49,936	62,853	7.70%
Orange County	1,932,705	2,410,556	2,846,289	3,416,037	15.40%
California	23,667,764	29,760,021	33,871,648	43,601,763	13.80%
United States	226,549,000	248,709,873	281,421,906	344,683,537	13.20%

The city of San Clemente has experienced a net increase of over 8,836 people since 1990, an increase of 21.5-percent. The median age of the population of San Clemente is 38 years. Orange County median age is 31, and the median age for California is 33.6. Orange County has a population of 281,782 of people over the age of 65, which is 9.9-percent of the population.

Using 2000 Census reports, the population of the city of San Clemente is 87.9-percent white. Minority populations include: Asian (2.6%), American Indian and Alaskan Native (0.6%), African American (0.8%), Native Hawaiian (0.18%); and other (5.1%). Approximately 15.9-percent of the population is of Hispanic or Latino heritage. There are 19,395 households and the average household size is 2.56 persons.

C Employment

Table E3 indicates the predominant sectors of employment for residents of the study area, according to the Profile of Selected Economic Characteristics: 2000, recently published by the U.S. Census Bureau. As shown in the table, the sales and office occupations are important in the region associated with the study area. Also, important sectors include: management and professional services, production and transportation occupations, service occupations, and construction and maintenance.

Table E3
San Clemente Shoreline Study
Employment by Industry,(2000)

Industry	San Clemente	Orange County	California
Industry Total	24,654	1,410,700	14,718,928
Farming & Mining	81	8,200	282,717
Construction	2,081	79,200	915,023
Manufacturing	2,482	190,000	1,930,141
Wholesale & Retail Trade	6,373	192,400	2,237,552
Transportation & Warehousing & Utilities	2,032	262,300	689,387
Finance, Insurance & Real Estate	2,035	110,600	1,016,916
Service	13,430	568,000	7,647,192

In 2002 the value of agricultural production was $344.3 million. That ranks the county 19th in the state of California. Leading agricultural commodities include nursery stock and cut flowers, strawberries, tomatoes, peppers, and avocados.

In Orange County, the unemployment rate in 2002 was 4.1% up from 3.0% in 2001. The city of San Clemente has a rate of 2.7% much lower than the county rate and California, which is 6.7%.

D Income

Table E4 summarizes pertinent information regarding income and effective buying power by household in the study area. Among the most common occupations are: sales and office occupations, 27 percent; Management, professional, and related occupations, 25 percent; Production, transportation, and material moving occupations, 20 percent; Service occupations, 19 percent; and Construction, extraction, and maintenance occupations, 10 percent. Approximately, 86-percent of the people employed were private wage and salary workers. In 2001, 10 percent of people were below the poverty line. Twelve percent of related children under 18 were below the poverty level, compared with 13 percent of people 65 years old and over. The median income of households in Orange County was $46,440. Eighty-eight percent of the households received earnings and 18 percent received retirement income other than Social Security. Twenty-one percent of the households received Social Security. The average income from Social Security was $10,523. As shown in Table E4, the per capita income and median household income, in the study area are substantially higher than figures for the county and state.

Table E4
San Clemente Shoreline Study
Income Levels by Household, (2000)

Income Distribution	San Clemente	Orange County	California
Total Households	19,457	936,154	11,512,020
Less than $15,000	1,403	81,576	1,615,869
$15,000-$24,000	1,416	81,207	1,318,246
$25,000-$34,999	1,921	92,352	1,315,085
$35,000-$49,000	2,710	137,223	1,745,961
$50,000-$74,000	3,836	193,379	2,202,873
$75,000 or more	8,171	350,417	3,313,986
Median Household Income	$63,507	$58,820	$47,493
Per Capita Income	$34,169	$25,826	$22,711

E Transportation

In 2000, there were 2,117,514 vehicles registered in Orange County alone. In 2003, the county had over 1,668 miles of streets, roads, and highways. Major interstate highways servicing the county include Interstate 5 (north, south) and I-405 (north, south). There are other freeways connecting cities notably the 91, 73; running east and west, and Pacific Coast Highway running along the coast. The mean travel time to work in the county is approximately 26 minutes, and 76-percent of workers drive alone. The county has John Wayne Airport located in Santa Ana that carries domestic flights. Orange County has a Metrolink train system that provides commuters with access to Los Angeles, Riverside, San Bernardino, Ventura, and North San Diego counties. The seven-year old commuter train operates a total of 126 daily trains running over 416 miles of track.

3 Without Project Conditions

A Without Project Damages

The without project damages represent the amount damages that would occur within the study area and throughout the period of analysis. The period analysis covers the timeframe between the years of 2010 to 2059. Also, the without project damages represent the damages that would occur due to wave force, inundation, and erosion of the shoreline.

The without project evaluation will measure the amount of damages that could occur to the infrastructure and structures throughout the period of analysis. The infrastructure includes the rock revetment that protects the Lossan railroad line. It is expected that the costs of rock revetment will be the largest damage category and a good gauge for estimating federal interest in a project. This study will mainly focus on the costs of maintaining the rock revetment. This report will only display the inventory of structures, and exclude the evaluation of damages of the structures until the next milestone.

B Engineering Analysis of Shoreline Erosion

The Corps Engineering Section estimated the average, minimal, and maximum erosion rate for the San Clemente shoreline by using data from two sources. The sources included the Coast of California Storm and Tidal Wave Study (CCSTWS) and the City of San Clemente beach width monitor program. The data is a compilation of measurements obtained in the 1980's through the present. Table E5 shows erosion rates at four locations in the study area. The shoreline change data sets are blended together to obtain a mean rate representative for the entire study area. The mean erosion rate is –0.20 m/yr (-0.7 ft/yr). The maximum erosion rate is –0.61 m/yr (-2.0 ft/yr) and the minimum rate is +0.38 m/yr (+1.24 ft/yr).

Table E5
San Clemente Shoreline Study
Summary of Long Term Shoreline Change Rates

Location	Erosion Rate m/yr (ft/yr)
Shorecliff	+.0.38(1.24)
Linda Lane	-.24(-.79)
T-Street	-.61(-2.00)
State Beach	-.33(-1.09)

C San Clemente Management Policy for Beach Facilities

Based on the Park and Recreation Department current policy, the department will protect the existing facilities as long as it is economically feasible (repair cost is less that 50% of the estimated value of the facility). Also, the repair or protective measure is environmentally safe, and erosion has not reached a point where protection is impractical or illogical. Once a potential protection project fails to pass any of the criteria, the city's policy is to move the facility further from the ocean. As this occurs, costs to rebuild will certainly increase due to additional costs of demolition and removal of the existing facilities, the relocation of utilities, the new design work and the constraints for building new facilities in areas that are currently at capacity or build-out.

Currently, the engineering analysis of the potential wave force, inundation, erosion damages to recreational facilities has not been completed. The evaluation of the dollar damages to these facilities will be completed for the next milestone.

D Public Facilities Vulnerable to Erosion and Wave Damages

The public buildings located in reaches 7 and 8 provide basic services and enhance the recreation experience for users at San Clemente Beach. Table E6 shows the square footage and depreciated replacement value of public buildings that are vulnerable to wave attack and erosion of the shoreline. The building costs for the structures along the shoreline are significant higher than inland, due to costs of protection (sheet pile and caissons) and the building materials for an ocean environment. Also, the building costs were inflated due high costs providing utility services to the building. The estimates of depreciate replacement value for structure was based on Marshall & Swift and the Corps Cost Engineering Section. The replacement cost of the pier was excluded from the analysis, since the pier is not susceptible to damage from the erosion of the shoreline.

Table E6
Depreciation Replacement Values of Facilities on Public Beach

Facility	Sq. Footage	Current Protective Measures	Depr Repl Value
Marine Headquarters	5675	Beach/Sheet Pile Wall	$885,000
North Beach Concession and Restroom	960	Sandy Beach/Caissons	$135,000
Linda Lane Restroom	660	Sandy Beach/Sheet Pile Wall	$54,000
Picnic Shelters north of Pier	500	Sandy Beach	$21,000
Concession south of Pier	800	Sandy Beach	$47,000
Restroom south of Pier	660	Sandy Beach	$64,000
Picnic Shelters south of Pier	500	Sandy Beach	$21,000
Restroom at T-Street Beach	1000	Sandy Beach/Sheet Pile Wall	$117,000
Concession stand at T-Street Beach	480	Sandy Beach/Sheet Pile Wall	$33,000
Restroom south of T-Street Beach	1000	Sandy Beach/Sheet Pile Wall	$78,000
Miscellanous playgrounds and fire rings	NA	Sandy Beach	$20,000
Total Costs			$1,475,000

E Erosion Damages to Lossan Railroad Route

The Lossan railroad line bisects the length of the project area. The railroad is constructed on conventional elevated crushed rock ballast. The railroad is constructed along the base of the bluff throughout the reach and is a prominent feature that completely separates the active beach from the bluff. The beach is only accessible via pedestrian underpasses/overpasses or storm water culverts interspersed along the length. Whereas typically the beach and bluffs are considered joined together as components in an active littoral system, the presence of the railroad completely isolates the bluff from the beach. Virtually all sediment inputs and bluff-related influences are restricted. Furthermore, the railroad resembles and acts as a protective revetment. In several areas the railroad is the primary structural feature that protects the bluffs and upland development from direct wave attack. In several areas the beach has completely eroded and exposed the railroad, thus, the railroad has fixed the position of the shoreline. Thus the railroad is the de facto protective structure. The railroad, acting as a protective structure and fixing the position of the shoreline, is assumed to be permanent and always exist throughout the project lifecycle. Therefore, the railroad is considered the landward boundary and no storm damages are considered landward of the railroad.

The Lossan corridor (Los Angeles to San Diego) is the only railroad link between San Diego and the rest of the United States for passenger and freight railroads to operate, including military operations. This corridor is a major transportation link for passenger traffic, second only to the Washington DC to Boston corridor in terms of Amtrak train density and ridership.

F History of Lossan Line

In 1882 the Atchison, Topeka, and Santa Fe Railway Company (ATSF) constructed the rail line connecting San Diego to San Bernardino, but this line was abandoned after two severe flood episodes that damaged the route. The ASTF constructed the Lossan corrider in 1888. The railroad line connected the cities of Fullerton and San Diego.

During the 1980's ATSF, Caltrans, Amtrak and Los Angeles, Orange and San Diego counties shared the costs ($79 million) of Lossan Rail Corridor Rehabilitation project. The project included replacement of the 50-year old jointed rail with new, heavier continuous-weld-rail; new wood railroad ties; installation or replacement of some power switches; and surfacing. In addition, since the 1980's the railroad and government agencies have spent $852 million in improving the infrastructure along the Lossan corridor.

The ATSF maintained and operated the Lossan corridor until 1993 when it was sold to the Orange County Transportation Authority (OCTA). The purchase by OCTA was funded by bond proceeds the passage of propositions 108 and 116 in 1990, and by the proceeds from local transportation sales tax measures. Conditions of the purchase from the ATSF included the obligation to continue operation of ATSF and Amtrak trains, and the protection of utilities within the right of way. OCTA has assigned the maintenance of the line and operation of commuter trains to Southern California Regional Rail Authority (SCRRA). This maintenance activity includes track and tie inspection and the periodic repairs. Also, there is on-going vegetation control and debris removal along the right-of-way, as well as periodic replacement of rip rap to protect the track bed from wave action.

Over the past ten years, the wave action in the San Clemente area has restricted train movements periodically, but the railroad facility has not been completely shut down by the threat of waves breaking over the revetment and the tracks. During the 1998 El Nino storm, the area suffered severe damage, and train movements were slowed to ensure safe passage. After the storms in 1998, SCRRA completed considerable repairs to the track and rip rap embankment.

The OCTA has spent $100,000 per year for the rip rap replacement. This rip rap had to be applied, at an increasing rate in recent years, to protect the railroad tracks from sand erosion. If the sand loss continues, the cost to maintain and extend the rip rap will be increase as well.

G Lossan Line Users

In 1996 the ATSF merged into a new corporation, the Burlington Northern and Santa Fe Railway (BNSF). Currently, this line connects with other railroad lines in San Diego. Also, this line connects to the Tijuana and Tecate areas of Baja California Norte (Mexico).

When Amtrak took over passenger service from the Atchison, Topeka & Santa Fe (BNSF) in 1971, only three daily "San Diegan" passenger train round trips were being operated. During the following thirty years Amtrak negotiated additional San Diegan round trips with some funding support from the Caltrans. Eighteen San Diegan trains currently operate daily along this route, nine in each direction. In 1992 Metrolink commuter rail service began on six local corridors centering in Los Angeles and Orange Counties.

Metrolink currently operates 137 train trips per day on seven routes in the Southern California region. Metrolink average weekday passenger trips were 35,472 in March 2003. Also, Metrolink operates 19 trains per day on the Orange County route. An average of 377 passengers board at Oceanside and San Clemente stations (June 2000).

The Amtrak's Pacific Surfliner provides service to the San Clemente station. The Surfliner provides service from San Diego to San Luis Obispo. Second only to Amtrak's Northeast Corridor in ridership, the service carries more than 1.7 million passengers in FY 2002. The Pacific Surfliner Corridor serves Southern California's key coastal population centers and connects two of the most congested regions in the country – Los Angeles and San Diego.

For the year 2020 SCRRA forecasts 58 trains carrying 17,760 per weekday and Amtrak forecasts 32 trains carrying 5,760,000 annual passengers (averages 15,781 per day but actually peaks on Friday, Saturday, and Sunday). In FY 2002 1,072,000 riders passed through the San Clemente area northbound and southbound trains.

The Burlington Northern Santa Fe Railway operates on average, 4 daily trains. Trains operating during the day average 4,800 tons which is approximately 60-65 trains cars in length. Trains operating at night are typically auto trains (the trains are approximately 6,500 feet in length). During periods of peak freight activity, BNSF may run 6 trains a day on this segment of the Lossan corridor. In addition to general freight, the line handles fuel gas, bulk chemical shipments to the Port of San Diego (principally potash), feed grain, automobile, lumber, and transportation, construction, and military equipment. Also, this line serves the Camp Pendleton Marine Corps Base, the Miramar Naval Air Station, the Southern California's San Onofre nuclear plant, and the San Diego Unified Port District.

Any prolonged service disruption on the LOSSAN Line, such as the mudslide that took at San Clemente/Dana Point in February 1993, results in more congestion in Interstate 5 due to additional passenger vehicles and trucks. Also, the increase traffic on Interstate 5 will add pollution to Los Angeles region by the increase in emissions from trucks and cars. For some commodities like the liquefied natural gas for Tijuana, no other economical delivery method exists. Businesses receiving freight service incur higher costs to move goods like grain, lumber, etc. when freight cannot move by rail. The LOSSAN line is a key transportation link in southern California's railroad infrastructure, and one that needs to remain open around the clock to accommodate freight, intercity passenger, and commuter trains.

H Revetment Maintenance

The method used to resist this erosion for the last several decades has been to place broken stone rip-rap along the ocean side of the track embankment. In earlier times, some rip-rap was waste concrete, however that material tended to break up leaving exposed reinforcing steel exposed to persons on the beach. The size of the stone is from four feet in maximum dimension down to four inches. The stone has come from various quarries in Southern California. Almost all of the rock applied in the 1990 is granite that has come from Corona or Newberry Springs. The rock is delivered to the roadbed area in railroad cars which dump to the side. Before and after dumping the rock, the construction equipment (tracked excavators and rubber tired end loaders) is used to arrange the rock into a uniform row, and to keep it clear of the PUC walkway area alongside the track. This work is done at night because of the need to occupy the tracks with the rail cars. The rock is placed on a 1:1 or 1.5:1 (horizontal to vertical) slope towards the beach, and to a height of about three or four feet higher than the rails. This height is to deflect large waves at high tides, which are otherwise observed to impact the tracks. This placement and replacement of rip-rap is all fixed in location to the 20 to 30 feet west of the centerline of the tracks. The SCRRA experience since 1993, and staff experience dating into the 1970's, is that the very steep piles of rock, often underlain by compacted sand. The next stage of erosion is that the high parts of the piled stone settles into these voids, lowering the height of the embankment. This is an approximately annual cycle, with the most erosion occurring in the winters. Over the last five years, rock has been installed about annually to replace that lost to erosion.

The use of random-dumped stone rip-rap has evolved over decades of practical experience and has not been studied or engineered by rigorous methods. It is believed to present an exposure to the ocean which is able to absorb significant energy and to capture some of the smaller stone and sand.

The operation of a railroad line is a continuous responsibility. The inspections and repairs that can be scheduled in advance and which do not disrupt train operations are performed on weekdays. Troubleshooting must be done at any time there are problems reported by trains or discovered by inspections. Many of the maintenance tasks must be done at night because of the many passenger trains operating during the days. These night projects are similar to the night work that Caltrans does on urban freeways in that it is scheduled to avoid disruption to the majority of users of the corridor. It does impact residential areas with some light and noise.

According to documents provided by the railroad, the railroad spends $200,000 to $300,000 (2000 price level) every three years to maintain the revetment. The study team assumed that the current average yearly cost for the maintenance of revetment would be rounded up to $100,000 and the director of Engineering & Construction for SCCRA verified this figure. This rip rap has been applied at an increasing rate in recent years, to protect the railroad tracks from sand erosion. If the sand loss continues, the cost to maintain and extend the rip rap will increase in future.

I Methodology for the Risk-Based Model

The model developed for the San Clemente Study used the principles of Risk & Uncertainty (R/U) in compliance with U.S. Army Corps of Engineers policy that requires all new Federally funded coastal studies incorporate the principles of R/U. U.S. Army Corps of Engineers policy guidelines for R/U are defined in Engineer Regulation 1105-2-101 (Dept. of Army 1996). R/U is intrinsic in water resources planning and design and arises from measurement errors and the inherent variability of complex physical phenomena.

This model incorporates R/U by utilizing probability distributions for variables and design parameters where appropriate. It is recognized that the "true" values of the design variables and parameters are frequently not known with certainty and can take a range of values. However, the likelihood of a parameter taking on a particular value by a probability distribution can be described. The probability distribution may be described by its own parameters such as mean, standard deviation, shape, and scale. In some cases, the probability distribution for a parameter may be well established in the engineering literature, or in other cases a best-fit distribution of the measured data may be applied.

The principles of Monte Carlo Simulation are used as the numerical integration technique. The proprietary computer program @RISK (Palisade, 2002) was used to run the R/U analysis. @RISK is an add-in to a standard industry spreadsheet package that provides the necessary tools for executing a Monte Carlo Simulation.

The integrated model used in the present study combines the coastal engineering and economic sources of risk and uncertainty within a life-cycle framework. The life-cycle model generates a plausible storm condition, calculates various coastal engineering parameters, and determines shoreline erosion and other damage mechanisms. These are linked to the property inventory to estimate life-cycle property losses.

<u>Seasonality</u>: This model is a single season model; seasonality of the wave climate is not considered. It is generally accepted that the most damaging storms in southern California occur during the winter months. Although it is recognized that very large wave events can and do occur during the summer season, the winter extratropical storms tend to cause the majority of the property losses.

<u>Single Storm</u>: This model is a single storm event model; multiple storms are not considered. It is recognized that several "storms" occur every winter season. In fact, it is generally accepted that storm "clusters" are responsible for some of the most damaging storm years in southern California.

A single annualized storm is believed to fairly represent the majority of the shoreline change and economic losses. It is well established that shoreline changes and the resultant economic damages tend to be cumulative throughout the storm season. However, there is little or no data that allows the full and quantitative delineation of the shoreline changes and economic damages attributed to individual storms in a cluster of successive storms. Shoreline change monitoring and measurement efforts typically are conducted on a time basis that is not in direct response to storm damages. In general it is typical that detailed descriptions of economic damages are recorded and compiled well after the storm season has ended. Therefore, there is no reliable method to individually distribute and compartmentalize the combined shoreline changes and economic damages that do occur to a sequence of storms.

The model employed in the present study is a spreadsheet-based model in which the Monte Carlo simulation is conducted by a spreadsheet add-in package. Use of the spreadsheet allowed each year of the economic life cycle is represented by one column of the spreadsheet. Thus, the spreadsheet nature of the model eliminated the numerical requirement to iterate for each life cycle year. Each iteration represented a new simulation that resulted in substantial numerical computational efficiency.

Simulation results were monitored for numerical convergence to evaluate the stability of output distributions during a simulation. A convergence criterion of 1.5% was established for convergence statistics for each output distribution.

J Without Project Maintenance Costs – Currents Conditions

The model calculated costs of the maintenance plan that is described in section H. This was deemed as the "non-engineered" revetment. The $100,000 per year average incurred under existing conditions was distributed on a per square foot basis throughout the four reaches that are currently protected by a revetment. The model started with $100,000 in the year 2002. In the future years, the revetment costs increased, with the additional areas that need to be protected by the revetment. Table E7 shows the first cost of the non-engineered revetment for one 50 meters cell to be $98,400 and the yearly maintenance cost of $2,173. The average annual maintenance costs for the current conditions is $218,800.

K Future Without Project Maintenance Cost Scenario

In May 2003, the California Coastal Commission (CCC) proposed changes to the current maintenance plan. The CCC has significant concerns regarding the impacts of the current maintenance plan in regards to natural sand supply and recreational resources. In order for the SCRRA to get a permanent permit for the revetment, the SCRRA must convince the CCC that the revised maintenance plan addresses these impacts. Currently, the SCRRA has not finalized these changes to the maintenance plan.

The study team developed the future without conditions based on the input from the representatives of SCRRA and City of San Clemente. The representatives concluded that for those reaches armored with a shore protective revetment, an engineered upgrade of the existing revetment is assumed in each 50-meter revetment cell whether the revetment is deemed necessary from a maintenance viewpoint or is damaged by storm-induced wave overtopping. However, for the ballast-only reaches, the entire reach will be armored with a new, engineered seawall when the cumulative total of one-third of the cells in the reach is damaged. Emergency measures to repair each 50-meter damaged cell are necessary until the total damages exceed one-third of the total cells in the reach. It is probable that an emergency repair may be applied to the damaged cell prior to the comprehensive upgrade or construction of a newly designed seawall during a severe storm event.

Table E7 shows the first costs, operation, maintenance, repairs, and rehabilitation (O&MN) costs for the engineering revetment and the seawall, and mitigation costs. Also, the data table shows the triangle uncertainty variance that was applied to each of the cost values.

Table E7
San Clemente Shoreline Study
R/U Model Construction and OM&M Costs Inputs

Economic Value	Price Per Foot	Cost Per Cell	Uncertainity Variance
O&MN Cost Non-Eng Revetment	$13.25	$2,173	+/-1%
O&MN Cost for Unimproved Ballast	$13.25	$2,173	+/-1%
O&MN Cost for Eng Revetment	$6.00	$984	+/-15%
First Cost for Non-Eng Revetment	$600.00	$98,400	+/-15%
First Cost for Upgrade to Eng Revetment	$200.00	$32,800	+/-15%
First Cost to Construct Seawall	$3,000.00	$492,000	+/-15%
O&MN cost for Eng Seawall	$30.00	$4,920	+/-15%
Mitigation Cost for Loss of Sediment Supply	$22.00	$3,608	+/-15%
Mitigation cost for Loss of Public Access	$200.00	$32,800	+/-15%

L Model Results

When the output distribution reaches the convergence factor of 1.5% the model will display the mean results of the net present value and the average annual costs for future without project conditions. Table E8 shows the net present value for future without project condition by reach. The average annual costs for future without project condition by reach is listed in Table E9. A significant portion of the damages is expected to occur in reach 6, which includes the San Clemente Pier and lifeguard headquarter building. Since reach 6 has no rock revetment, it is expected that the SCRRA will build a seawall in the next fifteen years. Due to high cost of constructing a seawall and short timeframe of construction, the damages will be significant higher than other reaches.

Table E8
San Clemente Shoreline Study
Net Present Value of Future Without Project Conditions

Reaches	Future W/O
Reach 1	$647,700
Reach 2	$2,407,200
Reach 3	$345,900
Reach 4	$517,200
Reach 5	$201,000
Reach 6	$4,121,400
Reach 7	$551,500
Reach 8	$1,733,200
Reach 9	$0
Total	$10,524,600

Table E9
San Clemente Shoreline Study
Average Annual Value of Different Scenario

Reaches	Future W/O
Reach 1	$39,000
Reach 2	$144,800
Reach 3	$20,800
Reach 4	$31,100
Reach 5	$12,100
Reach 6	$247,900
Reach 7	$33,200
Reach 8	$104,200
Reach 9	$0
Total	$633,000

M Study Conclusion

This evaluation does include all the possible future without project damages that would occur in the study area. The evaluation did not evaluate the possible damages to the recreational buildings and damages to the infrastructure. Eventually, the erosion of the shoreline is expected to destroy the functionality of the recreational buildings located on the beach. Table E6 details the recreational buildings located on the beach. The expected damages to the recreational buildings include the future cost of protecting the structure, damages from waves impacts and flooding, demolition costs, loss of structure value and possible costs of moving the structure landward. The possible damages to the infrastructure include damages to a pipeline of reclaimed water, utilities lines, and future pedestrian trail along the railroad revetment. All the following damages need to be evaluated over the period of analysis from 2010 to 2059.

The damages to the railroad revetment should represent significant portion of the total without project damages, should provide a good gauge of the federal interest in constructing a project in the study area. Also, the impacts of shoreline erosion on the recreational activities should provide significant portion of the damages. The beach attracts over 2.1 million visitors per year. Currently, significant portion of the visitors use the wet portion of the beach for their recreational activities, which degrades the users recreational value. An evaluation of the recreational value over the period of analysis should be completed before the next milestone.